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CONTENTS.

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DESIRABLE PRODUCT FROM THE TEACHER OF MATHEMATICS—THE POINT OF VIEW OF AN ENGINEERING TEACHER.[1]

THE school curriculum of to-day lies under the charge, vigorously pressed at the hands of many, of leaning to fads and being given over to poor teaching. The teaching of only two subjects seems to be excepted from the general charge of incompetency that is often made—namely, Latin and mathematics—and I have sometimes reflected upon the meaning and propriety of the exceptions. Returning to these reflections when your courteous secretary invited me to address you, I determined to lead you over some of this ground—old and often trod ground you may say—but nevertheless it is ground well worthy of surveying again and even again.

I think the charge of fads grows partly or wholly out of the character of work done in the kindergartens—under which name numerous sins are often cloaked by well meaning, accomplished, but highly impractical, and often incompetent, teachers. I am an earnest believer in the purposes of the kindergarten, but the practical results of its operation, where I have observed it, seem often to disseminate faulty methods of observation, poor workmanship in handicrafts and inaccuracy in thought. It is suggested that the pure kindergarten methods have their most important place in connection with the schools of social set-

[1] An address delivered before the general session of the Central Association of Science and Mathematics Teachers, November 25, 1904.

tlements and their like, which are found in the most densely settled portions of cities, and which have to do with children who find little or none of the gentle or softening influences of the average American home. These methods certainly bring a minimum of good to children of whom reasonable obedience and courteous bearing are expected in their home life.

To the kindergarten belongs the initial work of manual training. By that often abused phrase I particularly mean geometrical drawing and instruction in handicrafts of various kinds. Indeed, a relatively large proportion of the kindergarten pupil's time ought to be engrossed by manual training, because the brain is then specially amenable to training in the precise control of the senses; and this manual training ought to be carried up through the grades in the elementary schools with gradually decreasing allotment of time until it is nearly (or even entirely) succeeded by purely mental studies when the high school is reached. All that is now done with manual training in the high schools can be better done in the lower schools. But brains can be as easily produced by wishing, as precision of thought and act can be produced by an untrained teacher.

There is the rub in the situation. Poorly taught manual training is particularly dangerous because it encourages lack of precision in perception, performance and judgment, at the very time in his development when the habit of slovenly inaccuracy is most readily impressed upon the pupil. Less harm from poor teaching in this branch results in the high school than in the kindergarten, because the older child is less readily and less permanently affected by slovenly processes, if he has previously been under wise instruction. Also, better teachers, with reasonably good training, are available for the high school teaching of manual training, because better wages are there afforded. How can we expect—who should expect—accuracy of observation, precision of act and accuracy of thought to be inculcated in small children by a young woman who possesses not one of those important attributes herself, and who has never learned that they are important—indeed, essential—to the highest success in man or woman?

Gentlemen of the secondary schools, if you will lend your attention judiciously to reforming the schools below yours, and will really produce the reformation, you will be relieved of that disconcerting and mischievous pressure that is now directed towards securing for manual training a considerable portion of the time of the secondary school curriculum which is now occupied by what are commonly called disciplinary studies.

A few of the better universities acknowledge that a small amount of manual training is appropriate to the list of entrance requirements, and such an acknowledgment is quite usual by the engineering colleges (the University of Wisconsin admits not to exceed one unit out of the fourteen units of high school work accepted for entrance into engineering courses). Such a proportion is substantially as much as ought to be made a part of the high school curriculum, but it ought to be only the final capping of a stout pyramid of drawing and handicrafts which has its capacious lower leaf in the primary school or kindergarten. In this connection, let me say that much confusion exists in the minds of many regarding the relations of trades schools to high schools and of trades schools to university courses in engineering. Each of these has its own place, and they should not be confused.

Precision of observation, accuracy of execution and clear reasoning are necessary

to the best endeavor in all disciplinary studies, but particularly in mathematics. These attributes may be built up with peculiar success when the aid of rightly conceived and *wisely taught* manual training is invoked during the tender years of the pupil. But even when these attributes are possessed by all of your pupils, the fullest success in teaching mathematics will still demand a fixed purpose and high pedagogical ideals in the teacher, added to a sympathetic knowledge of his subject.

A *man* is a creature who honestly brings his undertakings to accurate results, even though the method adopted may not be the simplest or the one approved by academic authority. This requires an open mind, keen observation, analytical thinking and accurate powers of inference.

A parrot might glibly recite the rules for following an approved method, and then defend inaccurate results by the plea of carelessness, or haste in the particular instance.

The *man* may not know the rules as they are phrased in the books, but an inaccurate result is (for him) a matter of real chagrin and humiliation.

As the pupils now come to the colleges (perhaps I should refer more particularly to engineering colleges, as with them my experience more particularly lies) from the secondary schools, they ordinarily possess little power of clear thinking, power of initiative, regard for accuracy, or understanding of continuous intellectual effort. It is true that they are not yet mature in either body or mind, and too much should not be expected of them. But it is also true that their preparatory schooling has left them with a defective acquaintance with the construction of the English language and the spelling of English words, a still more defective acquaintance with French or German or a fairly good grounding in elementary Latin, a smattering of civics and history, a training in the elementary principles of arithmetic, geometry and algebra, *from which the factor of accuracy in application has often been omitted,* and perhaps an enthusiastic though often misguided interest in the physical sciences.

I do not wish you to think of me as reflecting on the industry of the secondary school teachers. The facts are as I have stated them, but I can truthfully say that, considering all of the conditions, there is probably no more painstaking and right wishing body of people than these teachers. It is the conditions that are not right. The schools encourage, as Herbert Spencer says, '*submissive receptivity* instead of *independent activity.*' The unfortunate situation is, perhaps, a result of the inexperience of school boards, or the inexperience, inadequate compensation or improper training of a large proportion of the teachers, or the crowding of the schools may overwork and cramp the best of teachers.

Many of the faults in the secondary school training (which has been the lot of students entering our engineering colleges) may be caused by a doubt that has recently seemed to unsettle certain educational circles on account of the question whether high schools shall be the 'people's colleges,' or remain in the station of secondary schools. This doubt is apparently not yet resolved in the minds of those who undertake to mold educational thought in the secondary schools; but the traditional old time secondary school training which produced men who could spell and cipher and who had received a thorough and accurate drill in at least one language is certainly to be given foremost place as a preparation for a college course. In my estimation, when accompanied with history and a year spent in civics and natural sci-

ence, it is not only an advantageous school course for preparing students for college, but it is a preferable course for those numerous young people who can not go through college.

Many of the errors of teaching in the universities are the result of an undiscriminating chasing after the popular cry, and many spurious pedagogical ideas are still propagated which were long since laid by the competent leaders. I presume that the same condition is found in the secondary schools. What engineering teacher can do his duty who does not understand the truly simple relation between theory and practice, and where can he find it better expressed than when reading the inaugural dissertation of Professor Rankine? What secondary school teacher can teach his best, whatever may be his instinctive capacity, who has not read Montaigne's essays on teaching or Spencer's little book on education, or who has not absorbed the point of view of some of the great teachers through adequate biographies?

Of the elementary mathematics taught in the schools, I have just said that the factor of accuracy in application is often omitted, or, if it is not actually omitted, it is largely neglected.

Contact with men entering college shows that:

The arithmetic class is taught the rules, but not the reasoning upon which the rules are founded or the overshadowing importance of impeccable accuracy in numerical results.

The algebra class is taught to transform (or, as I may call it, juggle) equations, but little thought is bestowed where the greatest thought belongs—that is, to the physical meaning of each form that is produced. This fault, I must admit, is not missing from the universities, and is propagated in the schools by association.

The geometry class is apparently taught by rote, and even where a show is made of encouraging the originality of the pupils it is likely to be more an illusion than a fact.

Large classes encourage teaching for the average mass, rather than the stirring of each individual as must be done to create the fullest results. Apparently in few mathematics classes are the pupils taught to scrutinize and check the results of their labors by means appealing more to the common sense than to cut and dried methods. Many years of observation with college students have shown me that the attention of secondary school pupils is seldom drawn to such useful processes for checking numerical results (which were taught with fidelity to our fathers) as 'casting out the nines'; and the worst of it is that the pupils have not been taught even the simple philosophy of our decimal system which might enable them to work out the processes for themselves.

If the causes that contribute to allow the pupils to reach the end of the secondary school training with their originality sleeping, their normal sense of accuracy lost and their best accomplishment in mathematics a parrot-like following of hackneyed method in familiar problems—if the causes from which these conditions spring are anchored in overcrowded classes, then it is your duty and privilege to cry aloud for more air, more breath of life, more chance to teach each living individual instead of the average of an inert class.

Mathematics is a tool—a powerful system of logic, an aid to reasoning—which confers power and advantage on the individual in proportion to the fullness of his possession. The value of mental discipline obtained while accomplishing that possession is inestimable. And the teacher's aim ought to be to make that possession most

complete in those respects which stimulate the powers of accurate (straight) reasoning.

It has seemed to me that the present teaching of mathematics is not so effective as that brought to bear on my generation in the secondary schools, and it likewise appears to me that my generation was less effectively taught to reason, through mathematics, than was my father and his generation.

I am not a reactionary or one who exalts the past above the present. But I see a reason for the present condition in the extended introduction of analytical mathematics and a consequent relegation of constructive mathematics to a minor place. The introduction of the analytical mathematics is not of itself to be regretted, but it seems to have brought with it a change in the method of teaching which is profoundly unfortunate. The teacher now feels under requirement to lead a large class over certain ground in a given time, and (to use the concrete example of algebra) he finds he may do so by expecting the students to learn the processes by the book, and solve the equations, but he has no time (nor strength, if the class is unduly large) to spend in the work which is really of overshadowing importance—that is, drilling the students to interpret the physical meaning of each pregnant transformation.

Unhappily this condition has had the support of the science departments (especially of mathematics and physics) in some of our great universities, where it has been held that the equation is the thing and the interpretation of minor moment; and with this support in high quarters, how should we expect the stupefying mechanical method to be banished from the secondary schools.

But, gentlemen, *the equation is not the thing.* The interpretation of the equation —an understanding of the real meaning of transformations, and a grasp of the relations of things, which lead to sound reasoning—is the feature of first importance to be derived from the study of mathematics.

The mental subsoil is stirred in developing physical conceptions of the relations of things, while even the sod may not be well broken in learning the processes of juggling equations. Stirring the mental depths often calls for the exertion of the utmost powers of good teaching, but poor teaching is inexcusable, unless, much easier as it is, it may be exacted by the undermanned and overcrowded conditions of some of our schools.

What constitute first-rate instincts in a teacher of mathematics may be illustrated by an anecdote:

Some years ago a mature graduate student who was in one of my college classes asked me if it would not be better to go slower at some places so that the class should *thoroughly understand the relations of things,* even if we did not cover the whole subject in the allotted time. This was text-book work and in an engineering subject of analytical character. We were then covering only ten or twelve duodecimo pages per day, but the book was one in which nearly every sentence was charged with important meaning and each mathematical expression, however simple or complicated, represented some important physical relations.

The student had been a college instructor with a fine reputation as a teacher of mathematics or mechanics, and since then he has become a professor of engineering. I have understood that he has strongly entrenched his reputation as a man whose students become young men of discreet thought, notable for resourcefulness and character.

What we need from the mathematics teacher is, not for them to produce young men who can juggle equations, but to produce young men who can recognize the relations of things.

My limit of time is presumably exhausted, and I will conclude. You probably will not all now agree with my opinions, but fair opinions honestly spoken ought to offend no one; and I am satisfied that my opinions will be sustained in the minds of the majority of experienced teachers in engineering colleges who have given careful thought to the question before us. When the University of Wisconsin puts into effect a year hence its promulgated additional requirements in algebra preparation for students entering the college of engineering, it is not so much because we particularly care for more pages of the book to be covered in the high schools, but because we hope that the students (with more time allotted to the subject) may attain more of the true powers of reasoning that come from searching for and recognizing the relations of things.

If a teacher's pupils are capable of transforming (juggling) equations correctly according to rule, without giving a thought to the meaning of the forms produced, or are capable of following through an arithmetical problem by the approved method without considering the reasonable accuracy of the numerical results, then that teacher's sowing has been choked with tares. But a teacher of mathematics who leads his pupils to give due thought in the course of their work to interpreting equations, to noticing the relations of things, and to scrutinizing and checking the accuracy of every numerical result (even though the pupils may evolve, for their own use, awkward and unapproved analytical methods)—that teacher's sowing is of golden wheat.

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THEORIES OF METABOLISM.[1]

The sum of the chemical changes which take place within the organism under the influence of living cells is called metabolism. This paper is to discuss the character of these changes and to consider, as far as we may, their cause.

It was Lavoisier who first understood that oxygen supported combustion and he compared life with the flame of a candle. He conceived the idea that hydrogen and carbon were brought to the lungs by the blood and there united with oxygen. It was, however, observed that the heat production was not confined to the lungs, and when Magnus found that venous blood was richer in carbon dioxide and poorer in oxygen than was arterial blood, the process of oxidation was placed in the blood. Ludwig in his later years believed this. The prevailing view, however, is that the processes of metabolism take place within the cells of the body.

Lavoisier believed that oxygen was the cause of the metabolism. Liebig thought that fat and carbohydrates were destroyed by oxygen, while proteid metabolism took place on account of muscle work. Voit showed that muscle work did not increase proteid metabolism and that the metabolism was not proportional to the oxygen supply. The amount of oxygen absorbed apparently depended upon what metabolized in the cells. He showed that although fat burned readily in the air, it burned only with great difficulty in the body; and that proteid burned with comparative difficulty in the air, but went to pieces very readily in the body. Voit believed that the cause

[1] A paper read before the New York Section of the American Chemical Society.

of metabolism was unknown, but that the process was one of cleavage of the food molecules into simpler products which could then unite with oxygen. Yeast cells, for example, convert sugar into carbon dioxide and alcohol without the intervention of oxygen. In like manner the first products of the decomposition of fat, sugar and proteid are formed in metabolism through unknown causes. Some of these preliminary decomposition substances may unite with oxygen to form carbon dioxide and water, others may be converted into urea, while others under given circumstances may be synthesized to higher compounds. In any case the absorption of oxygen does not cause metabolism, but rather the amount of the metabolism determines the amount of oxygen to be absorbed.

The statement is frequently met with in the literature of the subject that such and such a disease is the consequence of deficient oxidation power in the tissues. For example, it has recently been stated that alcohol decreases the oxidation power of the liver for uric acid. Such apparent decrease in oxidation power may be due to the fact that the protoplasm is so altered that the normal oxidizable cleavage products of uric acid are not formed and, therefore, no oxidation can take place. It is not due to lack of oxygen that sugar does not burn in diabetes, or cystin in cystinuria. There is the normal supply of oxygen present, but the cleavage of these substances into bodies which can unite with oxygen can not be effected, and hence they can not burn.

There is a difference of opinion as to whether the food substances must first become vital integers of the living cell, or whether the non-living food materials are metabolized without ever becoming a constituent part of the living protoplasm.

Pflüger holds the former view that incorporation of nutritive matter with the living substance is essential to its metabolism. He conceives that living proteid may contain the labile cyanogen group in contrast with dead proteid which contains the amino group. He illustrates this by Wöhler's classic experiment of the easy conversion of ammonium cyanate into urea.

$$NH_4OCN = (NH_2)_2CO$$

Voit's theory is that the living proteid is comparatively stable and that food proteid which becomes the circulating proteid of the blood is carried to the cells and promptly metabolized. The other foodstuffs are also burned without first entering into the composition of the cell.

A mass of living cells composing the substance of a warm-blooded animal has the same requirement of energy as any similar mass of living cells composing the substance of any other animal of the same size and shape. The reason for the metabolism lies in unknown causes within the cells. Liebig conceived the cause to be due to the swinging motion of the small constituent particles of the cells themselves. If this hypothesis be accepted the vibrations of the cells may be assumed to shatter the proteid molecule into fragments consisting of amino bodies, and to break down fat and sugar into substances of a lower order than themselves.

The uniformity of the energy requirement is illustrated by the following table showing the number of calories given off during the twenty-four hours by one square meter of surface in various animals and in man, in the condition of starvation.

	Weight in kilos.	Cal per sq. m. Surface.
Man	64	1042
Pig	128	1078
Dog	15	1039
Mouse	0.018	1188
Diabetic man	54	925

This illustrates Rubner's law of skin area, which holds that the metabolism is

proportional to the exposed area of the animal.

Even in pathological conditions a remarkable constancy of total heat production is apparent. Thus in such typical disturbances as anæmia, diabetes, gout and obesity, the general laws governing the output of carbon dioxide, the absorption of oxygen and the production of heat are found to be the same as in health. In fever the metabolism and heat production increase and this to a certain extent on account of the warming of the cells. In exophthalmic goiter there is probably an increase in metabolism, due to the chemical stimulus of an excessive production of iodothyrin in the thyroid gland, while in myxœdema the absence of the same substance causes a considerable reduction in the metabolism. Drugs may influence the course of the metabolism, iodothyrin increasing it and morphine profoundly diminishing it, but on the whole the most striking fact is not the variability, but rather the uniformity, of the processes concerned.

Within recent years the work of Kossel, Fischer, Hofmeister and Levene has given a more definite conception of the composition of proteid than was before possible. There is every indication that the proteid molecule consists fundamentally of groups of amino fatty acids banded together. Proteids vary with the integral components of their chemical chains. It has long been known that the end products of tryptic digestion include such substances, but Kutscher first showed that continued tryptic digestion resulted in the complete transformation of proteid into these amino-acids. Cohnheim discovered erepsin, an enzyme derived from the intestinal wall, which rapidly converts albumoses into these substances.

On chemical analysis, using methods developed in Emil Fischer's laboratory, the cleavage products of various proteids appear distributed as shown in the following table.[2]

COMPOSITION OF PROTEID.

	Casein.	Gelatin.	Elastin.	Globin from Haemaglobin.	Edestin.
Glycocoll	0	16.5	25.75	0	3.8
Alanin	0.9	0.8	0.58	4.19	3.6
Leucin	10.5	2.1	21.38	29.04	20.9
Pyrrolidin carboxylic acid	3.1	5.1	1.74	2.34	1.7
Phenylalanin	3.2	0.4	3.89	4.24	2.4
Glutamic acid	10.7	0.88	0.76	1.73	6.3
Aspartic acid	1.2	0.56	—	4.43	4.5
Cystin	0.065	—	1.0	0.31	0.25
Serin	0.23	—	—	0.56	0.33
Oxy-γ-Pyrrolidin carboxylic acid	0.25	3.0	—	1.04	2.0
Tyrosin	4.5	—	0.34	1.33	2.13
Anninovalerianic acid	1.0	—	—	—	*
Lysin	6.80	2.75	—	4.28	2.0
Histidin	2.59	7.62	—	10.90	1.0
Arginin	4.84	0.40	0.3	5.42	11.7
Tryptophan.	1.5	—	—	*	*

* Present.

The proteid metabolism in plants and animals occurs in striking similarity to the changes brought about by enzymes and hydrolytic agents acting on proteid outside of the tissues. Thus in the germinating seed Schultze[3] finds that asparagin, leucin, tyrosin, histidin, arginin and lysin arise from the metabolism of proteid. The occurrence of leucin and tyrosin in the liver and urine in such diseased conditions as phosphorus poisoning has long been known and Abderhalden and Bergell[4] report the presence of glycocoll in rabbit's urine after the administration of phosphorus. Urine after phosphorus poisoning may also contain phenylalanin[5] and arginin.[6] Wakeman[7] finds an altered quan-

[2] Abderhalden, E., *Zeitschr. f. physiol. Chem.*, 1905, Bd. 44, p. 17.

[3] Schultze and Castero, *Zeitschrift für physiologische Chem.*, 1904, Bd. 44, p. 455.

[4] Abderhalden and Bergell, *Zeitschrift für physiologische Chem.*, 1903, Bd. 39, p. 464.

[5] Abderhalden and L. F. Barker, *Zeitschrift für physiologische Chem.*, 1904, Bd. 42, p. 524.

[6] Wohlgemuth, *Zeitschrift für physiologische Chem.*, 1905, Bd. 44, p. 74.

[7] Kossel, *Berliner klinische Wochenschrift*, 1904. No. 41.

titative relationship between histidin, arginin and lysin in the composition of liver substance after phosphorus poisoning, arginin in particular being reduced below the quantity found in the liver of the normal dog. This possibly suggests a specific action by phosphorus on certain cell proteids rich in arginin which are essential to vitality. All forms of proteid decomposition follow, therefore, the pathway of cleavage into amino acids.

The question arises, to what extent may the amino bodies formed within the intestine be regenerated into proteid? It is believed that the cells of the intestinal villus regenerate fat from fatty acid and glycerin, since neutral fat alone is found in the thoracic duct. But all the starch fed is not regenerated into starch, nor is maltose regenerated into maltose in the body. Much may be burned as dextrose and only a part is transformed into glycogen. Long ago Schultzen and Nencki[8] stated that a certain amount of amino bodies formed in digestive proteolysis was absorbed and burned, and that the absorbed proteid itself followed the lines of an enzymatic cleavage into amino bodies. In the light of newer knowledge several authorities have recently elaborated theories along similar lines. It has been pointed out by Folin[9] that there is little evidence of reconstruction of all the proteid ingested. He cites the experiments of Nencki and Zaleski,[10] which showed that the portal blood during digestion contains four times as much ammonia as arterial blood, and that the mucosa of both stomach and intestine yield large quantities of ammonia. The inference is that the ammonia of the portal vein is derived from ammonia produced in the mucosa as well as from that which normally originates in the intestine during tryptic proteolysis.

The existence of denitrogenizing enzymes is afforded by the example of the guanase and adenase of Walter Jones,[11] which respectively convert guanin into xanthin and adenin into hypoxanthin with the liberation of ammonia.

Folin believes that the greater part of the proteid ingested undergoes a denitrogenization through the hydrolysis of the amino cleavage products. Such a reaction would read

$$\equiv CNH_2 + H_2O = \quad COH + NH_3.$$

The ammonia may be converted into urea within the organism, and the nitrogen free rest may be converted into sugar. The simplest expression of this is seen in the experiment of Neuberg and Langstein,[12] who found glycogen in the liver and lactic acid in the urine of a rabbit following the ingestion of alanin. The transformation of alanin into lactic acid may be written

$$CH_3 \cdot CHNH_2 \cdot COOH + H_2O = CH_3 \cdot CHOH \cdot COOH + NH_3.$$

Alanin. Lactic Acid.

The transformation of lactic acid into sugar is demonstrated by the experiment of A. R. Mandel,[13] who showed an increase in the sugar output in diabetes after the ingestion of lactic acid.

Stiles and Lusk[14] have shown that ingestion of the mixture of amino bodies produced from the tryptic digestion of meat may yield sugar in large quantity in diabetes.

[8] Schultzen and Nencki, *Zeitschrift für Biologie*, 1872, Bd. 8, p. 124.

[9] Folin, *American Journal of Physiology*, 1905, Vol. 13, p. 117.

[10] Nencki and Zaleski, *Zeitschrift für physiologische Chem.*, 1901, Bd. 33, p. 206.

[11] Jones and Winternitz, *Zeitschrift für physiologische Chemie*, 1905, Bd. 44, p. 1.

[12] Neuberg and Langstein, *Archiv für Physiologie*, Suppl. Bd., 1903, p. 514.

[13] Mandel, 'Proceedings of the American Physiological Society,' *Am. Jour. of Physiol.*, 1905, Vol. 13, p. xvi.

[14] Stiles and Lusk, *American Journal of Physiology*, 1903, Vol. 9, p. 380.

Wolf[15] finds that none of these amino substances has any effect on the blood pressure of animals, so far as he has examined them.

Although some proteid metabolism may take place as above outlined, it is an undoubted fact that proteid may be synthesized in the body with the formation of new tissue, and also that proteids injected into the blood stream, as in cases of transfusion of blood serum, are rapidly destroyed and the nitrogen eliminated as urea. The conditions of proteid metabolism may, therefore, be entirely similar to those of starch metabolism, (1) digestive hydrolysis, (2) partial combustion of the end products, and (3) possible regeneration of portions of the end products into substances similar to the originals, but characteristic of the organism, *i. e.*, glycogen and body proteids. In the case of proteids the second or metabolic process involves the partial passage of the end products through the glucose stage. The third or regenerative process is promoted by such a proteid as casein, which yields a variety of cleavage products.

Folin[16] has discovered that a man fed with creatin free food eliminates a constant quantity of creatinin nitrogen in the urine irrespective of the amount of nitrogen ingested with the food. Thus the urine of one man contained 16.8 grams of total nitrogen with 0.58 gram of creatinin nitrogen. The same man at another time, after large carbohydrate ingestion, eliminated 3.60 grams of total nitrogen and 0.60 gram of creatinin nitrogen. Folin conceives that the constancy of the creatinin and uric acid output is a true index to the necessary protoplasmic breakdown, and would define the nitrogen of such destruction as the endogenous nitrogen. To what extent, if any, urea nitrogen enters into this essential life metabolism he is not prepared to say. The same idea was expressed by Burian[17] in an article published ten days later than Folin's. Burian believes that purin bases are a constant product of muscle metabolism and that these are oxidized to uric acid, a part of which is further converted into urea. This process of itself would evolve urea as a constant product of the endogenous nitrogen metabolism. According to this newer conception the cells of the body through the swinging motion of their particles do continually break down their own protoplasm with the production of creatinin, purin bases, and perhaps other substances. These same cells may also break up exogenous amino radicles derived from ingested proteid or circulating proteid itself.

Neuberg and Loewi[18] have made an observation which is not in accord with the idea that proteid metabolism normally passes through the amino-acid stage. These authors investigated a case of cystinuria, a condition in which cystin formed from proteid can not be burned, but is eliminated in the urine. After ingesting leucin, tyrosin and aspartic acid these also were almost quantitatively eliminated in the patient's urine, although the normal organism burns them. Since these substances were not eliminated by the patient on a normal diet, the presumption is that they can not be normal products of intermediary proteid metabolism. The authors find it difficult to explain this according to the conception of a general breakdown of proteid into amino acids. This experiment lacks confirmation.

[15] Wolf, *Journal of Physiology*, 1905, Vol. 32, p. 171.

[16] Folin, *American Journal of Physiology*, 1905, Vol. 13, p. 66.

[17] Burian, *Zeitschrift für physiologische Chem.*, 1905, Bd. 43, p. 532.

[18] Neuberg and Loewi, *Zeitschrift für physiologische Chemie*, 1904, Bd. 43, p. 338.

As regards fat metabolism Geelmuyden[19] is inclined to the opinion that oxybutyric acid, aceto-acetic acid and acetone are normal metabolism products derived from members higher up in the series.

As regards dextrose Stoklasa[20] announces that all animal and vegetable cells contain enzymes capable of converting dextrose into alcohol and carbon dioxide. He[21] also finds a ferment in animal tissues able to convert sugar into lactic acid. He quotes Oppenheimer's experiment, showing that whereas fresh normal blood yielded little lactic acid on standing at 37° C., much greater amounts were formed if dextrose was added. He believes that this lactic acid is subsequently converted into alcohol and carbon dioxide.

Embden[22] comes to the conclusion that blood sugar perfused through the liver may be broken up into lactic acid. It has been previously shown that lactic acid could be converted into dextrose and it is a curious fact that this same dextrose may pass through the lactic-acid stage on its way to oxidation.

A. R. Mandel[23] in the writer's laboratory has shown that lactic acid disappears from the blood and urine in phosphorus poisoning if diabetes be induced. Here the mother substance of the accumulating lactic acid is removed in the urine. Any considerable production of alcohol in tissue metabolism, while possible, does not seem probable in light of the known physiological action of the substance.

[19] Geelmuyden, *Zeitschrift für physiologische Chem.*, 1904, Bd. 41, p. 128.

[20] Stoklasa, *Centralblatt für Physiologie*, 1903, Bd. 17, p. 465.

[21] Stoklasa, Jelinek und Cerny, *Centralblatt für Physiologie*, 1903, Bd. 16, p. 712.

[22] Embden, 'Verhandlungen der 6sten Internationalen physiologen Congress,' *Centralblatt für Physiologie*, 1905, Bd. 18, p. 832.

[23] Mandel, 'Proceedings of the Am. Physiol. Society,' *American Journal of Physiology*, 1905, Vol. 13, p. xvi.

Rubner[24] gives the following theory of metabolism: Living proteid, through the vibrations of its particles, metabolizes the food substances. The action resembles catalysis. The energy liberated reacts on the particles of protoplasm, causing a change in their position and a cessation of metabolism. The particles then return to their original position and the cycle begins again. These processes require a fixed amount of energy. Rubner does not give his reasons for believing in this rhythm of excitation and rest.

The quantity of the combustion depends on the power of the cells to metabolize (Voit). In the resting state this metabolic power of the cells is influenced by the 'law of skin area' (Rubner). Temperature (cooling or warming) and nerve excitation (muscle work, chemical regulation) affect the power of the cells to metabolize, perhaps through an increase in the oscillation of the particles, an effect which is in turn maintained at the expense of the energy derived from metabolism. Living protoplasm metabolizes in accord with its necessities at the time, and never more. ' Large quantities of nutrient materials furnished will not increase cell metabolism. If food be ingested above the requirement for the organism, any excess will be retained in the body. The kind of metabolism depends upon the constitution of the fluid feeding the cells, and whether proteid, carbohydrates or fats have been ingested.

Each ingested foodstuff exerts a specific dynamic action (Rubner). At a temperature of 33° C. the ingestion of the starvation requirement of energy in the form of fat increases the requirement for energy ten per cent., carbohydrates raises it five per cent., proteids thirty per cent. In other words, in the case of meat, in order to obtain calorific equilibrium about 140 calories

[24] Rubner, 'Von Leyden's Handbuch der Ernähungstherapie,' 1903, p. 78.

must be ingested instead of 100, if that represents the starvation requirement. Rubner[25] explains that the cells of the body do not require more energy after meat ingestion than in starvation, but that the heat produced by a preliminary cleavage of proteid into dextrose on the one hand, and into a nitrogen containing rest on the other, while yielding heat to the body does not furnish the actual energy for the vital activities of the protoplasm. This is furnished principally by the dextrose derived from the proteid. Although it is necessary to abandon the older theory which pronounces glycogen (or dextrose) a direct cleavage product of proteid, still the explanation of Rubner remains tenable if interpreted in the newer light. If the energy requirement of the cell remains constant at 100, even after the ingestion of 140 calories of proteid, then 71.4 per cent. of the total heat value of the proteid is the quantity actually used for the vital processes. Since it has been shown in the writer's laboratory that meat proteid yields 58 per cent. of dextrose in metabolism, it may be calculated that 52.5 per cent. of the total energy of proteid may be available for the cells in the form of sugar. A balance of 19 per cent. must be obtained from other compounds, while 28.5 per cent. of the total heat value is wasted as heat without ever having been brought into the service of the life processes of the cells. Perhaps this 28.5 per cent. of heat loss represents the quantity produced by the cleavage of proteid into amino bodies and the denitrogenization of these radicles.

The constancy of the energy requirement in metabolism makes difficult the explanation of the action of the various ferments found in the body. These are of two varieties, hydrolytic and oxidizing, but these from the very principles of our knowledge must be subservient to the requirement of the living cells, and not themselves masters of the situation, as, for example, they are in the autolysis of dead tissue. It seems to be the requirement of the mechanism of cell activity which determines metabolism, and not primarily the action of enzymes, whose influence appears to be only intermediary.

Friedenthal[26] shows that proteid, colloidal carbohydrates, fats and soaps are not oxidizable in the cellular fluids without previous hydrolytic cleavage. After hydrolysis, however, the oxidases may effect an oxidation of the smaller molecules. The necessity of the hydrolytic ferment is seen in the non-combustion of dextrose after the extirpation of the pancreas, the organ by which the ferment is supplied. Oxygen and the oxidases are present in ample quantity, but the sugar is not burned unless it be broken by its specific ferment. In the meantime the cell avails itself of a compensatory energy supply from other sources. It is impossible to apply anything similar to Ehrlich's side-chain theory to this condition of affairs, for the metabolism does not depend upon the satisfaction of chemical affinities, but rather upon a definite law of utilization of energy equivalents.

However clearly formulated the laws of metabolism may be, and many of them are as fixed and definite as are any laws of physics and chemistry, still the primary cause of metabolism remains a hidden secret of the living bioplasm.

Graham Lusk.

University and Bellevue Hospital Medical College.

[25] Rubner, 'Gesetze des Energieverbrauchs,' 1902, p. 380.

[26] Friedenthal, 'Verhandlungen der Berliner Physiologischen Gesellschaft,' *Archiv für Physiologie*, 1904, p. 371.

SCIENTIFIC BOOKS.

Notes on Anthropoid Apes. By the Hon. Walter Rothschild.

This paper, in the last number of the *Proceedings of the Zoological Society of London*

(1904, Vol. II., Pt. II., 413–440), is based in the main upon recent studies by Professor Matschie, published in the *Sitz. Ges. Naturf. Freunde.*

A review of the systematic portion of Mr. Rothschild's paper could not be profitably undertaken at present, at least by an American zoologist, for lack of material by which values could be estimated, and still more by reason of the absence from his paper of almost all details in support of its conclusions except a few of dubious significance. The doubt may be expressed, however, whether even the German naturalist, though his material has much exceeded that ever before brought together, has had anything like a sufficient amount to establish the nature and the taxonomic value of many of his characters. One point which may be briefly noticed is Matschie's proposal, adopted by Rothschild (p. 413), that the gibbons should form a family, Hylobatidæ, quite apart from the other anthropoids. It appears to me that nothing could be further from sound principles of classification. By reason of their somewhat intermediate anatomical structure, the gibbons might, perhaps, be used to break down the separation of anthropoids and old-world monkeys into two families, but they are far too closely allied to the first in all distinctive characters, to be added as a third group in the series.

Reference may also be made here to the biological improbability of four subspecies of orang, each presenting the same dimorphic forms (p. 434).

The changes in nomenclature, proposed chiefly by Matschie, are so serious in their results that they need examination. It is proposed to transfer the generic name *Simia* Linn. from its time-worn association with the orang to the chimpanzees, and to apply to the former the name *Pongo* Lacép. Now a complete reversal in the relation of a generic and specific name a century and a half old, with the upsetting of all depending nomenclature, should be shown to be unavoidable before it is proposed. Is it so here? The contention is that it results from taking the tenth edition of the 'Systema Naturæ' (1758) as the starting point, instead of the twelfth edition (1766), for the reason that *Simia satyrus* of the tenth was based on the *Satyrus indicus* of Tulpe (1641), which Mr. Rothschild holds to be so unmistakably a chimpanzee that 'we can even distinguish the exact race to which it belongs.'

The whole question, therefore, hangs on the certainty with which this animal can be identified. To me it appears doubtful, as it did to Hartmann, what animal Tulpe really meant. He calls it *Satyrus indicus* and gives the habitat as 'Africa, Asia.' The '*crinibus nigris*' of his description is the one character to distinguish it from the red orang, but it does not serve to distinguish one species of chimpanzee from another, or more than doubtfully from a young gorilla. Turning to Tulpe's figure the zoologist of experience with living anthropoids is likely to recognize much more resemblance to the orang than to the chimpanzee in the head, the small ear, the protuberant paunch, the size of the great toe and in the whole attitude of the animal.

Linnæus had really never seen any of these apes and his names are based on statements of other authors who were not able to differentiate the red ones of the Oriental region from the black ones of the Ethiopian, and his genus *Simia* of the tenth edition does not rest surely —to quote the American code—upon 'a designated recognizable species * * * or plate or figure.' In the twelfth edition his *Simia satyrus* is, without question, the orang, the chief reference being to Edwards's plate 213 (1758), which being colored leaves no doubt as to which animal is figured. The fact is that *Simia* Linn. is merely a composite of all the monkeys known to that author, and has with others of his genera been imposed upon literature more by reverence for his name than through any exact application borne by them. This being true in many cases, and *Simia satyrus* of the tenth edition not being certainly identifiable, rather than overturn the whole nomenclature of two genera, or even worse to reverse it, it seems quite within legitimate practice to regard it as a *nomen nudum* as far as the tenth edition is concerned, and let it take date from its first unquestioned use in the twelfth.

An unfortunate result of the contrary view held by the two authors is that *Pongo* Lacép. (1799) takes the place of *Simia* for the orang. Unfortunate, for however much the proper use of this word has been confused by later authors, old Andrew Battell, in 'Purchas' made it clear that the native name *pongo* belongs to the gorilla, and while it is true that some of the codes now in use do not consider that grievous misapplication in meaning is cause for removal, it may be doubted if any rule which serves to perpetuate error in fact stands on a lasting base where scientific exactness is the object.

Simia satyrus being transferred to a species of chimpanzee, the proper name for the orang, according to Mr. Rothschild (p. 421), is *Pongo pygmæus* (Linn.). The paper of Linnæus's understudy, Hoppius, in the 'Amœnitates Academicæ' (1763), which is the reliance for this, is not really binominal and should not be considered. The first available use of *pygmæus* is in Schreber (1796), where it is based on Tyson's excellent figure of a chimpanzee. This is adopted by Rothschild for one of the chimpanzees, as *Simia pygmæa* (Schr.); the orang being *Pongo pygmæus* (Linn.)—an ill-judged and indefensible confusion.

All these lamentable changes may be avoided by the manner of treatment I have suggested, which appears to me to be quite within the rules. Present synonymy will be undisturbed and an appalling amount of confusion will be escaped. How great this is will be seen on attempting to correlate Mr. Rothschild's nomenclature with some known species. The only change required is that *Pan* Oken (1816) seems necessary for the chimpanzee, but this does not entail any alteration in specific names.

If it is to be regretted that Mr. Rothschild (p. 421) has followed Matschie so closely as to continue the erroneous date of '*Satyrus* Lesson, 1799'—which should be 1840—it is, at least, unalloyed gratification to be assured (p. 440) that the distinguished author and patron of zoological science is prepared to lead continental and American zoologists in the campaign for a system of pure trinomials.

Arthur Erwin Brown.
Zoological Gardens, Philadelphia,
May 27, 1905.

SCIENTIFIC JOURNALS AND ARTICLES.

The American Naturalist for June contains the following articles:

E. W. Berry: 'Fossil Grasses and Sedges.

H. W. Rand and J. L. Ulrich: 'Posterior Connections of the Lateral Vein of the Skate.'

H. W. Rand: 'The Skate as a Subject for Classes in Comparative Anatomy; Injection Methods.'

T. H. Romeiser: 'A Case of Abnormal Venous System in *Necturus maculatus*.'

R. H. Howe, Jr.: 'Sir Charles Blagden, earliest of Rhode Island Ornithologists.'

C. R. Eastman: 'The Literature of Edestus.'

SOCIETIES AND ACADEMIES.

The Botanical Society of Washington.

The twenty-ninth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, May 27, 1905. The following papers were presented:

Evolutionary Status of the Laminariaceæ: Walter T. Swingle.

Mr. Swingle's paper was illustrated by specimens from the algal herbarium of Mrs. W. T. Swingle. It was pointed out that of the twenty-two genera belonging to the true Laminariaceæ (*Corda* and *Adenocystis* being excluded) twelve (or over one half) are limited to the Pacific coast of the United States, from Lower California to British Columbia. In all, sixteen genera occur within these limits, while two more occur in Alaska and one more in New England, making nineteen genera in all from the United States territory in North America, or *over four fifths of the known genera.* In this territory there are fifty-one species, or almost exactly half of the one hundred and five species now known from the whole world.

The Laminariaceæ were shown to be cold-water algæ and are limited in their distribution chiefly by the summer temperatures of the sea water. The family originated in the

northern Pacific Ocean, or at least here was where their greatest evolutionary progress occurred. Sixty-four species occur here and fifty-five are found nowhere else. All the twenty-two genera occur in the northern Pacific. In the southern hemisphere, where the temperature conditions are favorable to the growth of these algæ, as is shown by the prodigious size attained there by *Macrocystis*, and by its extreme abundance, only three genera occur containing but fourteen species, all but two restricted to the southern hemisphere. These species are probably descendants of forms that crossed the equator during the glacial period when the ocean had a much lower temperature in the tropical zone. That period has occurred in the southern hemisphere; at least it is shown by the failure of *Macrocystis* to cross into the northern Atlantic Ocean, where it would find a larger region admirably adapted for its growth.

These algæ attain the greatest length of any plant, *Macrocystis* reaching a length of 400 to 700 feet or over. Some of the forms, such as *Palagophycus* and *Nereocystis*, are annuals and must grow much faster than any other organisms in order to attain in the course of a few months their enormous length (100 to 200 feet or over).

The large size and high differentiation of tissues attained in this group, and especially the occurrence of well-marked species and very distinct genera, render it highly probable that sexuality occurs in spite of the prevailing opinion of algologists to the contrary.

The Flora of a Sphagnum Bog: C. E. WATERS.

An account was given of a sphagnum bog in Ann Arundel County, Maryland. The characteristic plants of the bog proper, of the low wet woods along the stream flowing through it, and of the surrounding dry woods, were shown to be of unusual botanical interest. In the dry woods *Quercus prinoides, Q. nana* and *Castanea pumila*, together with *Kalmia angustifolia, Vaccinia* and other heaths, are abundant. *Iris verna, Chrosperma muscætoxicum, Gaultheria, Rhus toxicodendron* and *R. radicans*, etc., are common. In the more open parts of the bog are found *Sarracenia purpurea, Drosera rotundifolia, D. intermedia, Eriocaulon decangulare, Utricularia* sp., *Castalia odorata* (in three or four inches of water), *Lycopodium adpressum* and *Blephariglottis cristata* have been found. Just below the bog is a shallow pond in which occur *Brasenia peltata, Potamogeton* sp., *Nymphœa advena, Castalia odorata*, and a rapidly increasing colony of *Marsilea quadrifolia* introduced six or eight years ago. Around its margin *Blethia* and several heaths are found. No *Isoetes* has ever been discovered, in spite of apparently ideal conditions. In the wet woods are very large colonies of *Woodwardia areolata, Nephrodium simulatum* and *Osmunda cinnamonea*, together with the form *glandulosa*, for which this is the type locality. *N. cristatum, N. boothi* and *N. spinulosum, Woodwardia virginica, Smilax walteri, Magnolia virginiana, Blephariglottis blephariglottis, Perularia flava*, and many other plants are found. In the rather swift stream with gravelly bottom *Vallisneria spiralis* is plentiful. Practically none of the common spring flowers usually found in low rich woods are known to occur there. Many other common plants are also missing, one of the most notable being *Equisetum arvense*, which is abundant along railroads, etc., in Baltimore County, but has not been seen in the region under discussion. The absence of *Typha* in the bog was especially noted, and in the discussion which followed the paper the fact was brought out that it is rarely if ever found growing with *Sphagnum*.

THE twenty-eighth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, April 29, 1905. The following papers were presented:

Recent Results with the Use of Copper in City Water Supplies: KARL S. KELLERMAN.

The use of copper for eradicating algal pollution is now generally recognized as the most practical successful method of dealing with this troublesome phase of water engineering.

Copper has been proposed, also, as an agent for disinfecting water supplies contaminated with pathogenic bacteria, and considerable discussion has been aroused as to the advisability

of this application of the copper method, except in cases of extreme necessity. There are two ways of using copper as a water supply disinfectant. One plan is to treat the supply directly, in the reservoir if there be one, or at the intake gallery if the water be drawn from a lake or stream. In the latter case the treatment necessarily must be continuous. The second plan is to treat water before filtration. By the use of suitable chemicals, all the copper is precipitated and removed from the water by the subsequent filtration.

Albuquerque, N. M., and Columbus, O., are examples of the first plan of treatment. These two cities greatly reduced the number of typhoid cases during epidemic seasons, and the chemical examinations that were made failed to show copper in the water drawn from faucets of consumers.

Anderson, Ind., is an example of the second plan of treatment, and even with the filters laboring under structural defects[1] it seemed possible to remove all bacteria usually supposed to indicate sewage contamination.

Disease Resistance in Plants: W. A. Orton.

The Occurrence of Extractives in Apple Skin: Herbert C. Gore.

Herbert J. Webber,
Secretary.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 603d regular meeting was held May 27, 1905. The evening was devoted to papers on absolute electrical measurements with a description of the experiments now in progress at the Bureau of Standards.

Dr. K. E. Guthe spoke on the 'Methods and Apparatus Employed in the Absolute Measurement of Electric Current.' After a short introduction regarding the purpose of absolute electrical measurements, the speaker described and discussed the different methods and apparatus which have been employed for the absolute measurement of an electric current and —by the use of a known resistance—of the electromotive force of standard cells. The tangent galvanometer and similar methods are based upon the knowledge of the horizontal component of the earth's magnetic field and this can hardly be determined more accurately than to 1 in 2,000, except by the most refined methods. The different forms of current balance make use of the absolute value of gravity. In the electrodynamometer methods the preliminary measurements include the determination of the elastic properties of the suspension. The electrodynamometer which is being constructed at the Bureau of Standards was described more fully. Finally the results obtained for the electrochemical equivalent of silver were compared and the need for new determinations with reliable coulometers pointed out.

Professor E. B. Rosa presented 'The Methods and Apparatus Employed in the Determination of v, the Ratio of the Electromagnetic to the Electrostatic Unit of Electrical Measurement.' After a discussion of the older work the apparatus now in use by the speaker and Dr. Dorsey was described. A rapidly charged and discharged spherical condenser is inserted in one arm of a Wheatstone bridge and the galvanometer deflection brought to zero; the quantity which is regulated by hand is the number of charges per second. The resulting value of v seems to lie between 2.9964 and 2.9968×10^{10} cm.-sec. —a range of 1/5000.

In the discussion that followed Dr. Bauer put the precision of the determination of H, the earth's horizontal magnetic force, at 1/4000; an instrument may be sensitive to 1/20000, yet differ from another by 1/500; and Mr. Wead spoke of the disregard of the masterly research of Cornu on the velocity of light, in comparison with the results under less widely varied conditions of the brilliant American experiments.

Charles K. Wead,
Secretary.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

The regular monthly meeting of the section was held at the American Museum of Natural History, on Monday evening, May 15. The papers presented were as follows:

[1] I am informed that these defects are now remedied.

Relation between Ionization and Combustion in Flames: F. L. TUFTS.

This paper was a preliminary communication concerning work that is still in progress. The method employed in determining the electrical conductivity of a flame has been described in a previous paper (*Physikalische Zeitschrift,* 5 Jahrgang, No. 3, pp. 76–80), and some results of applying it to a study of combustion have been given in an extract published in the *Physical Review* (Vol. XX., No. 3, p. 186). The present paper gave the results of investigations carried on for the purpose of determining the influence, on the electrical conductivity of a gas flame, of mixing CO_2 or air with the illuminating gas before supplying it to the burner.

The results showed that for small flames, showing little carbon luminosity, the admixture of either CO_2 or air caused no marked increase in the electrical conductivity, the amount of gas consumed per second being kept constant. For very small flames the admixture of either caused a decrease in the conductivity. For large flames, however, the admixture of either CO_2 or air caused an increase in the conductivity, which continued until enough CO_2 or air had been added to destroy the carbon luminosity, when the conductivity was as much as twenty-five per cent. larger than for a flame consuming the same quantity of undiluted gas. Continuing the addition of CO_2 beyond this point caused a decrease in the conductivity until the flame was extinguished. Continuing the addition of air caused at first a slight decrease, until the inner blue cone became well developed, when the further addition of air caused an increase in the conductivity, the conductivity reaching a larger value than it had on the disappearance of the carbon luminosity.

The Rate of Recombination of the Ions in Air: L. L. HENDREN.

The experiments described were undertaken to determine by a somewhat new method the absolute value of the coefficient of recombination of ions in air and more especially its variation with the pressure. The ionizing agent was a very active solution of radium chloride spread over the surfaces of two large parallel metal plates. By this means a very large ionization was obtained compared with that obtained by previous observers using the Röntgen rays. The results showed that as the pressure decreases the coefficient of recombination decreases with an increasing rate from a value of 5,500 at atmospheric pressure to 1,000 at 10 mm. pressure.

Radiation Pressure and Differential Tones: G. B. PEGRAM.

It was pointed out that the differential tones heard on sounding loudly two tones of different pitch may be considered as arising from the radiation pressure of the sound waves acting on the ear-drum. While the question of radiation pressure, or the pressure on any surface that is reflecting or absorbing energy coming up to it, has not admitted of a general treatment, such a pressure, proportional to the energy per unit volume of the medium transmitting the energy has been shown theoretically to exist in many cases, and proven experimentally in some. In the case of sound waves the theoretical treatment of the pressure on a reflecting surface is not at present satisfactory (see Poynting, *Phil. Mag.,* April, 1905), but experimentally it has been measured by Altberg and shown by Wood in a striking manner by an experiment described in the *Physical Review.*

Now if two tones of different pitch are sounded together, beats ensue, so the amount of energy coming up to the ear varies periodically with the rise and fall in loudness of the resultant sound. But when the most energy is coming up to the ear, or when the sound is loudest, the radiation pressure on the ear-drum is greatest; when the energy coming up to the ear is least, or when the sound is faintest, the radiation pressure is least. The effect of this variation of pressure on the ear-drum will be to set it into vibration with a period equal to that of the beats, and so, if the beats are of proper frequency, cause the sensation of a tone of that frequency, that is, the differential tone of Helmholtz.

While this explanation of differential tones from the standpoint of radiation pressure has,

perhaps, the same mechanical basis as Helmholtz's explanation, it seems not amiss to approach it in this way. An attempt is being made at a mathematical treatment.

C. C. Trowbridge,
Secretary.

DISCUSSION AND CORRESPONDENCE.

HIGHER AND LOWER.

To the Editor of Science: In the *American Naturalist* for June, on page 413, L. J. C. takes exception to the custom of referring to animals as 'higher' and 'lower,' on the ground that these terms tend to give the student an idea that the vertebrate affinities lie in a direct chain, rather than forming a complicated, branching system.

This criticism will strike some as a little captious since the terms do not imply a direct connection, but merely that some animals are on a higher plane than others, just as the dwellers on the fifth floor of an apartment house are higher than those on the fourth floor. The terms generalized and specialized fail to convey the idea intended because a highly specialized animal may be low in the scale of life. The sloth is more specialized than the monkey, but it would naturally be termed a lower animal; thus though what we call the 'higher' animals are, as a rule, more specialized than the 'lower' forms, they are by no means invariably so. To revert to the apartment house it may be said that a family on the fifth floor might be related to one on the fourth and another on the sixth and yet, as a whole, the fifth floor people would be higher than those below.

F. A. L.

A DENIAL.

To the Editor of Science: In a circular sent out by The Macmillan Company advertising one of their recent publications, the assertion is gratuitously made that I 'uphold Wallace's position.' Kindly allow me the space to deny the statement and to explain that it arose first from a misapprehension, which was later compounded by a clerical error—not mine.

Hubert Lyman Clark.

SPECIAL ARTICLES.

THE FISHES OF PANAMA.

In the Zoological Club of Indiana University in 1885 or 1886 President D. S. Jordan gave a résumé of the facts known at that time concerning the relation of the marine faunas on the two sides of Panama. It was jokingly remarked at that time that at the rate of progress the canal might be finished by 1900 and that zoologists would have to bestir themselves to record the faunas as they exist before the Panama canal would mix things up. It is now 1905 and the canal is not finished. In the meantime the marine faunas have been dealt with by

1. Gregory, L. W.: 'Contributions to the Palæontology and Physical Geology of the West Indies,' *Quart. Journ. Geol. Soc.*, Vol. 4, 1895, pp. 255–312.

2. Faxon, Walter: 'The Stalk-eyed Crustacea,' *Mem. Mus. Comp. Zool.*, Harvard College, Vol. XVIII., 1895, pp. 1–292.

3. Gilbert, C. H., and Starks, Edwin C.: 'The Fishes of Panama Bay,' *Mem. Cal. Acad. Sci.*, Vol. IV., pp. 1–226.

Gilbert and Stark's conclusions are that:

"The ichthyological evidence is overwhelmingly in favor of the existence of a former open communication between the two oceans, which must have been closed at a period sufficiently remote from the present to have permitted the specific differentiation of a very large majority of the forms involved." They found that 'of the 82 families of fishes represented at Panama all but 3 (Cerdalidæ, Cirhitidæ and Nematestiidæ) occur also on the Atlantic side of Central America; while of the 218 genera of our Panama list, no fewer than 170, are common to both oceans.' Fifty-four out of a total of 374, or 144 per cent., of the Pacific coast species are identical with Atlantic coast species.

I have just finished a consideration of the geographical distribution of the freshwater fishes of tropical America and Patagonia as applied to the Archihelenis-Archiplata theory of von Ihering. The details will appear in one of the volumes of the Hatcher reports of Princeton University. The evidence there collected indicates that the Pacific slope fauna

of tropical America has been derived from the Atlantic slope fauna. Only three of the genera of fresh-water fishes of the Pacific slope are peculiar to it; all the rest are identical with Atlantic slope genera. Even many species are identical on the two sides. The indications are that in the main the Pacific slope fauna was derived from the Atlantic slope fauna in times much more recent than the obliteration of the interoceanic connection between the Pacific and Atlantic. An examination of the distribution of the genera with representatives on the Pacific slope on the Atlantic side of the continent shows that nearly all have a very wide range and are found either in the Rio Magdalena or the Chagres. This indicates that the present fresh-water fauna of the Pacific slope crossed the divide somewhere near Panama. It is to be borne in mind that a barrier which may be ample to keep apart two marine faunas is not necessarily a barrier to the intermingling of two fresh-water faunas. It is quite within the range of possibilities that the Atlantic slope fauna ascended the Chagres and succeeded in crossing the low divide and descended the Pacific rivers. The Chagres route has a rival farther south. In Colombia the Cordilleras form four separate chains. The eastern, east of the Rio Magdalena, the central, between the Magdalena and its tributary, the Cauca, the western, west of the Cauca, and finally, a coast range. Between the western Cordillera and the coast Cordillera is a trough whose highest point is but 300 feet above sea level.

	Pacific Slope.	Atlantic Slope.
Rhamdia cinerascens Günther	Western Ecuador.	Chagres.
Rhamdia wagneri Günther	Bayano.	Chagres.
Pimelodus clarias (Bloch)	Bayano.	Chagres.
Pimelodella modestus (Günther)	Esmeraldas.	Chagres.
Pimelodella chagresi (Steind.)		Chagres.
Pimelodella gracilis (Val.)		Chagres.
Ancistrus chagresi (Eigenmann & Eigenmann)		Chagres.
Hemiancistrus aspidolepis Günther	Bayano.	
Chætostomus fischeri Steind	Bayano.	
Loricaria variegata Steind	Bayano.	
Loricaria uracantha Kner & Steindachner	Bayano.	Chagres.
Loricaria lima Kner	Bayano.	Chagres.
Sturisoma panamensis Eigenm. & Eigenm	Bayano.	Magdalena.
Hoplias malabaricus Bloch	Bayano.	Chagres.
Hoplias microlepis Günther	Western Ecuador.	Chagres.
Curimatus magdalenæ Steind	Mamoni.	Magdalena.
Brycon striatulus (Kner)	Pacific slope of Panama.	Chagres.
Astyanax panamensis Günther	Bayano.	Motagua.
Astyanax rutilus Jenyns	Western Ecuador.	Chagres.
Astyanax æneus Günther		Chagres.
Rœboides guatemalensis Günther	Huamuchol.	Chagres.
Gasteropelecus maculatus Steind	Bayano.	
Luciocharax insculptus Steind	Bayano.	Magdalena.
Eigenmannia humboldti (Steind)	Mamoni.	Entire east slope.
Pœcilia gillii Kner & Steind		Chagres.
Pœcilea punctatus Kner & Steind		Chagres.
Symbranchus marmoratus Bloch		Entire east slope.
Gcophagus jurupari Heckel		Chagres.
Cichlasoma parma (Günther)		Chagres.
Cichlasoma godmanni (Günther)	Bayano.	

In the west Cordilleras to the east of this trough arise two rivers, both of which flow into the longitudinal valley, where one, the Atrato, flows to the north into the Caribbean,

the other, the San Juan to the south, and then through a break in the coast Cordilleras to the west to the Pacific Ocean. The height of land separating the two systems scarcely reaches a height of 100 m. This waterway is one of the strategic points in the geographical distribution of South American fishes and it is more than to be regretted that there is not a single record of a fresh-water fish from either of these rivers!

We are a little more fortunate about our knowledge of the fishes of the two sides of Panama, but are far from an exhaustive knowledge on the subject.

It would certainly be a disgrace not to make an exhaustive study of the fresh-water faunas of the two slopes before there is a chance of the artificial mingling of the two faunas. It ought to be urged upon congress to make provision for the biological survey of the canal zone if the president or the bureau of fisheries does not already possess authority to provide for it. The work should be undertaken at once.

For the biological survey of the Atrato-San Juan route we must depend upon private enterprise, and it is to be hoped that the means for so interesting and profitable work will not be lacking when the volunteers for the work are so numerous and willing.

On the preceding page I give the fishes recorded from the Chagres on the Atlantic and the Bayano and its tributary, the Mamoni, on the Pacific side of Panama, together with the distribution on the Atlantic or Pacific slope of species found in one of the rivers, but not in the other. C. H. Eigenmann.

The Number of Young of the Red Bat.[1]

During the summer of 1904 four females of *Lasiurus borealis* with their young came under my observation, the data from which add to the information contained in a recent article on the subject by M. W. Lyon, Jr., in *Proc. U. S. National Museum,* Vol. 26, pp. 425–426, recording the capture of a female of this species with four nursing young, at Washington, D. C., June 18, 1902.

The Milwaukee specimens were all taken in the daytime clinging to the trunks of shade trees between the sidewalks and curbs in thickly populated residential parts of the city.

On July 14 a female with a single rather large young clinging to her was brought to me at the Public Museum. A few days later a female with three much smaller and less developed young was brought in after having been kept in captivity for a day or two until the mother had died. The young of this group were approximately the size of those figured by Mr. Lyon in the above-cited paper.

On July 23 a female with four larger young was brought to the museum. In this case the mother and young were alive. They had been confined for some hours in a pasteboard box and were quite restless. The half-grown young were clinging indiscriminately to each other and to the mother, who seemed fairly mobbed by her numerous progeny. A few days later I was shown another female with but a single young.

Of this bat Mr. Lyon cites observations of two having two young each, two having three and the instance under his own observation of one having four. Adding my own observations to this, we have the following records for number of cases and number of young: 2×1, 2×2, 3×3 and 2×4.

On the face of this tabulation it would appear that three is the more common number of young and that a single young is as frequent as four. However, it is not improbable that the females with single young may have lost others of their families either by death or by their accidentally becoming detached.

Two embryos were found in each of two females included in the above table and three embryos were found in two other included instances; consequently, it is certain that either two or three young may be born, but it does not appear equally certain that as small a number as one may occur at a birth, although that number appears to be common to genera other than *Lasiurus* and, as Mr. Lyon states, probably *Dasypterus*.

[1] Presented before the Wisconsin Natural History Society, March, 1905.

It is interesting to note, as pointed out by Mr. Lyon, that this unusually large number of young is coincident with the possession of four mammæ, whereas two is the number known in other bats.

That the mammæ of an animal should be as many as the normal number of young produced would appear to be a reasonable proposition, but that the normal number of young equals the number of mammæ is quite a different one, from which many exceptions will suggest themselves. For instance, the seals have four mammæ, yet one young is the rule and two the exception among the species with which I am familiar.

The fact of an increased number of mammæ in these bats correlates well with the observed fact of an unusual number of young, and I would be pleased to know of farther observations that may tend to establish what is the average number.

HENRY L. WARD.
PUBLIC MUSEUM, MILWAUKEE.

BOTANICAL NOTES.

PLANT CELL STUDIES.

UNDER the title of 'Studies on the Plant Cell' Dr. B. M. Davis is bringing together in a series of articles published in the *American Naturalist* (May, 1904, to April, 1905) what is known of the structure and activities of the plant cell. This is necessary because of the inadequacy and incompleteness of the accounts to be found in even the most recent botanical text-books. The author hopes, also, to 'help to change an attitude toward investigations on the plant cell that is unfortunately too prevalent among botanists,' *i. e.*, to regard cytology as a very special field with an elaborate technique beyond the capabilities of the average botanist. In carrying out this plan the author divides the subject into six sections, viz.: (I.) The structure of the plant cell; (II.) the activities of the plant cell; (III.) highly specialized plant cells and their peculiarities; (IV.) cell unions and nuclear fusions in plants; (V.) cell activities at critical periods of ontogeny in plants; (VI.) comparative morphology and physiology of the plant cell. The treatment under each of these heads, as far as published, is very satisfactory, and the author has certainly succeeded in making a most lucid statement in regard to every point. Where necessary he does not hesitate to indicate our lack of knowledge in regard to any structure, as when he discusses the nucleolus, and says that its substance is not well understood. Yet he does not refrain from stating his belief where it may be an aid to a clearer general understanding of the subject, as in the discussion of the pyrenoid, which he conjectures will prove to be a metabolic center of the chromatophore which is more or less prominent according to conditions of nutrition, whose most conspicuous activity is 'the formation of starch by the direct transformation of portions of its substance.'

In the discussion of direct-cell division the author suggests the possibility that this may be a reversion to early ancestral conditions, mitosis being regarded as phylogenetically a later process. With regard to centrospheres the author recognizes their existence in thallophytes only. As to the theory of the permanence of the chromosome Dr. Davis says 'it can hardly be said that the doctrine is established.'

In passing we note that the author regards the plasmodium of the slime molds as a coenocyte, and further that coenocytes of all kinds are to be regarded as multinucleate cells, and therefore units, instead of compound structures whose cells have not become separated by walls.

In the last article (IV.), devoted to cell unions and nuclear fusions, the author draws a sharp line of distinction between those which are sexual and those which are asexual. Under the latter (asexual) he includes the fusions of amoeboid cells to form plasmodia, the nuclear fusions in the teleutospores of smuts and rusts, and the nuclear fusions connected with 'double fertilization.' The remaining articles of this instructive publication will be looked for with keen interest.

LEAF INTUMESCENCES.

IN the Sixteenth Annual Report of the Missouri Botanical Garden Dr. Hermann von Schrenk contributes an article on the interesting problem of the cause of intumescences

which sometimes occur on the leaves of various plants. After a historical discussion of leaf-intumescences as observed by other investigators, the author describes the experiments which he made by spraying cauliflowers with various chemical substances. He found that by using ammonium copper carbonate he could produce intumescences at will, varying from minute papillae to large wart-like excrescences, dependent upon the size of the drops of the spray. Sections of these artificially produced intumescences showed that the mesophyll cells had become enormously enlarged, first lifting up, and later rupturing the epidermis. The giant cells were very thin-walled, and occurred in hair-like rows in which the outer cells soon died and became filled with air, while in those lying deeper 'very much reduced chlorophyll grains could be found.'

By means of careful experiments the author concludes that the peculiar growth of these cells is due to chemical stimulation of a kind hitherto unrecorded. Attention is directed to the fact that somewhat similar intumescences containing giant cells are formed as a result of insect punctures, which it is surmised are due to 'some chemical influences exerted by the parent insect, the egg, or the larva.' It is to be hoped that the experiments which the author has now in progress may throw additional light upon this interesting subject, especially the connection between these chemically produced giant cells and those produced in insect galls.

THE CALIFORNIA POPPIES.

Dr. E. L. Greene, of the United States National Museum, publishes a revision of the California poppies (species of *Eschscholtzia*) in the June number of *Pittonia*. The paper is a continuation of work begun more than twenty years ago, and continued from that time to the present. The result is somewhat startling, even in this day of many species of hawthorns and violets. We may well repeat the author's remark, 'that the species are so numerous, one might well regret,' which he follows with this his own defense: 'but nature has yielded them, doubtless even more of them than are here enumerated.' All told the paper describes 112 species, about three fourths of which are described here for the first time. More than two thirds of all the species enumerated are annuals.

THE SMUT-FUNGI OF NORTH AMERICA.

Under the title of 'North American Ustilagineae' Dr. G. P. Clinton publishes in the *Proceedings of the Boston Society of Natural History* (Vol. 31, No. 9) a paper of two hundred pages on the systematic botany of the smut-fungi of North America. The paper is the result of ten years of work (the last two years in the cryptogamic laboratory of Harvard University), during which the author has engaged in: (1) economic studies of the species found in Illinois, published in bulletins 47 and 57 of the Illinois Agricultural Experiment Station; (2) systematic studies, of which the present paper is the outcome; (3) the distribution of exsiccati, one century of which appeared in January, 1903; (4) spore germination studies, now under way.

In the present paper the specific descriptions are based upon the author's examination of the available material, which includes practically all of the European and American exsiccati. This insures a broader treatment than the order has hitherto received at the hands of fungologists. It is significant of the conservative tendencies of the author that although he describes 205 species and varieties, he finds it necessary to make but nine new species. Nor does he find it necessary to erect any new genera, so that his 'new names' are but three.

The order includes two families, Ustilaginaceae, represented by *Ustilago* (72 species), *Sphacelotheca* (16), *Melanopsichium* (1), *Cintractia* (14), *Schizonella* (1), *Mycosyrinx* (1), *Sorosporium* (9), *Thecaphora* (9), *Tolyposporella* (8), *Tolyposporium* (2), and *Testicularia* (1); and Tilletiaceae, represented by *Tilletia* (19 species), *Neovossia* (1), *Tuburcinia* (2), *Urocystis* (12), *Entyloma* (127), *Burrillia* (3), *Doassansia* (11), and *Tracya* (1).

An admirable specific systematic list of host plants; a table showing the distribution of our species in other countries; a list of the more

important articles relating to the smut-fungi, and a full index complete this important contribution to our knowledge of this group.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

ARCHEOLOGICAL NOTES.

ICHTHYOLOGICAL NAMES.

MUCH attention was given by the older ichthyologists, notably Conrad Gesner, Rondelet, Artedi, Linné and Cuvier, to classical names of fishes, and their identification with well-known forms. In this country Louis Agassiz, upon the occasion of his rediscovery of *Parasilurus aristotelis* (*Proc. Amer. Acad.*, III., p. 325), was one of the first to bring home the importance of comparing ancient and modern vernacular names of plants and animals, his remarks being ably seconded by a later communication from Professor Sophocles in the same volume.

Within recent years President Jordan and H. A. Hoffmann[1] have attempted a thoroughgoing revision of classic and modern designations of the Hellenic fish fauna, overlooking, however, some of the best work that has been done by their predecessors in this field. For instance, they seem to have taken no heed of the extremely valuable historical and bibliographical works of Artedi, nor of the indispensable commentaries of A. Koraes on the fishes mentioned by Galen and Xenocrates. *À propos* the last-named author, we owe to Koraes the correction of Artedi's error in confusing the physician Xenocrates with the illustrious philosopher of the same name who flourished, as the Swedish naturalist gravely tells us, '*anno mundi 3630, circiter.*'

Amongst the numerous attempts that have been made to identify Aristotelian species, two or three are of superior merit. These are the 'Index Aristotelicus,' published by the Berlin Academy, Aubert-Wimmer's 'Aristoteles Tierkunde' (Leipzig, 1868), and Sundevall's 'Thierarten des Aristoteles' (Stockholm, 1863). A work that might serve as a model for a revised *Synonymia Piscium Græca*, apart from the author's peculiar ideas on animal symbolism, is D'Arcy W. Thompson's 'Glossary of Greek Birds' (Oxford, 1895). Writing in the same year, H. Lewy argues very plausibly for a Semitic origin of a great many Greek names of plants and animals, including fishes. Thus, when we say tunny, carp, chameleon, etc.,—though Mark Twain can not consistently allow this—we approach pretty closely to the speech of Adam. Other contributions of real value that deal with the etymology of the Greek fauna are the following: Nicolas C. Apostolides, 'La pêche en Grèce' (Athens, 1883); T. de Heldreich, 'La faune de Grèce' (Part I., Athens, 1878); D. Bikélas, 'Sur la nomenclature de la faune grecque' (1878), and Dr. Erhard's 'Fauna der Cycladen' (Leipzig, 1858). Finally attention may be called to the newly discovered Byzantine 'Fish Book,' a work dating presumably from the thirteenth century, for the elucidation of which scholars are indebted to Professor Krumbacher, of Munich.

Before leaving this subject, there is one feature in Homeric zoology which deserves notice. Fish, the great delicacy of Attic days, never enters into the diet of the great chiefs, who partake of great meals of roast meat in contradiction of all that we know of any historical Greeks, as Professor Mahaffy has shown, from the earliest to the present day. Even the early athletes trained on cheese, and the people were probably never a meat-eating race. The Dublin professor is inclined to believe, with all its implied significance respecting authorship, that the exclusion of fish from Homeric banquet scenes is 'a piece of deliberate archaism.

PREHISTORIC DARWINIANS.

ZELLER and Osborn have critically investigated the extent to which evolutionary ideas were developed among Ionian philosophers several centuries before our era, and it is doubtful if their main conclusions can be controverted. One must marvel, therefore, at the fertile ingenuity of a French writer, M. Henri Coupin,[2] who has out-Champollioned Cham-

[1] 'A Catalogue of the Fishes of Greece,' etc., *Proc. Acad. Nat. Sci. Phila.*, 1892, pp. 231–285.

[1] J. P. Mahaffy, 'Problems in Greek History,' p. 49 (London, 1892).

[2] 'Le poulpe et la croix gammée,' *La Nature*, May 20, 1905, p. 396.

pollion in deciphering for us records which purport to show the prevalence of evolutionary ideas amongst Pelasgian races upwards of 2,000 years before Christ.

Compared with this feat of modern philologists, the reading of the handwriting on the wall, or of cuneiform inscriptions, is as mere child's play, for in the present case the records that have come down to us from proto-Mycenæan times are neither written nor inscribed. They are different from the papyrus rolls obtained at Herculaneum, although, like them, they have lain buried for ages in the spot aptly termed by Fouqué a 'prehistoric Pompeii' (Thera). In what form, then, are the records? Vase-paintings, scenes and symbols represented on *objets d'art*,—in a word, pictographs! But we may read even picture-writing, provided only we have the key. This M. Coupin triumphantly declares he has found: "Avec cette clef," says he, "on peut lire sans difficulté une foule de petits 'rébus' que personne ne comprendrait sans elle." The key is furnished by a new interpretation of the swastika, a design which has been exhaustively discussed in this country by Thomas Wilson, in the Smithsonian Report for 1894, and more recently by Mrs. Zelia Nuttall. That it is capable of unlocking terrible and profound mysteries may be judged from the following specimens of M. Coupin's 'translation':

> On this bronze fibula (Fig. 11) one reads from right to left: 'From aquatic animals (fishes), through the generative force of the sacred octopus, birds are descended.' On another design: 'Birds have issued from the water by virtue of the sacred octopus, or by a virtue analogous to that of the sacred octopus. * * *'

Already we have had to endure learned disputations tending to show that the far-famed Polyphemus was founded upon seamen's accounts of the gorilla, the present habitat of that animal affording no difficulties to the theorist; and within the last year or two, all semblance of discrimination has been abandoned by certain German writers in their interpretations of Homer's Scilla. Now that we have encountered Darwinism in full swing something like forty centuries ago, it remains only to bring to light a Coptic version of the nebular hypothesis, or a table of lunar distances from the ruins of Yucatan. Through abuses, even a good method may be brought into undeserved reproach; and this seems to be strikingly true of mythological interpretation.

NAMES OF THE GORILLA AND ORANG-OUTAN.

The discussion by Mr. Forbes in *Nature* (LXIX., p. 343) on the derivation and proper form of the word *orang-outan*, which in Malay means 'forest-man,' leads one to inquire why the specific name of the gorilla, first bestowed upon it by Savage in 1847, should have become almost universally superseded by the title subsequently proposed by Owen. Authors who agree with Owen in regarding this ape as generically distinct from the chimpanzee employ the designation *Gorilla* for the genus, but not for the species. Thus, Huxley in his 'Natural History of Man-like Apes,' and Flower and Lydekker in their treatise on 'Mammals' refer to it as *Gorilla savagei*. On the other hand, the older views of Wyman and Savage are endorsed by such expert mammalogists as P. L. Sclater and Arthur Keith, who defend the appellation of *Anthropopithecus gorilla* (Savage).

It seems to be pretty clearly established that only one species of the gorilla is known, the scientific discoverer of which was Savage; and to this species only one name is applicable, which is that which has become everywhere familiar in popular usage. The story of the origin of the name is interesting, since it harks back to the voyage of Hanno, the famous Carthaginian navigator of the fifth century before our era. There is not the slightest reason for discrediting the narrative of the 'gorillas,' as related in the *Periplus*, Pliny confirming the fact that their skins were exhibited in Carthage, and nearly all authorities agreeing that the southernmost limit of the expedition, where these animals were taken, was only a few degrees above the equator. But the identification of Hanno's 'gorillas' with anthropoid species now inhabiting equatorial Africa is a more difficult matter, though it appears certain they were not the apes which

we are accustomed to understand by this name, or to which Battell gave the name of Pongo, or 'greater monster.' They are supposed by many to have been chimpanzees.

C. R. EASTMAN.

HARVARD UNIVERSITY.

WORK OF THE DEPARTMENT OF TERRESTRIAL MAGNETISM OF THE CARNEGIE INSTITUTION OF WASHINGTON FOR 1905.

Office Work.

I. *Continuation of the study of the secular variation* and compilation of data and preparation for publication on a comprehensive, uniform plan. [The investigations have already progressed far enough to have warranted beginning at once the observational work referred to below.]

II. Discussion and publication of the data on the *magnetic perturbation* observed during the *eruption of Mont Pelée,* Martinique, 1902. [It is hoped to have this work in published form by end of year.]

III. *A general study of the laws of the diurnal variation* to serve as the basis for determining corrections and their reliability for the reduction of field observations.

IV. *Special investigation of magnetic storms* with the view of determining a working method for the discussion and analysis of such fluctuations. [These studies are being conducted under the direction of Professor Adolf Schmidt, at Potsdam, with the aid of funds supplied by the department. Professor Schmidt hopes to be able to contribute a paper on the subject towards the close of the year.]

V. Continuation of a *card catalogue* of publications and investigations in terrestrial magnetism and terrestrial electricity and allied subjects and collecting of information of work done and being done so as to avoid as far as possible needless duplication.

Field Work.

In pursuance of the plan for the completion of a general magnetic survey of the accessible regions of the globe within a period of fifteen to twenty years and of the general investigation of the secular variation, the following observational work is now in actual progress. In all likelihood, the requisite funds for this vast undertaking will be supplied chiefly by the Carnegie Institution of Washington, and in fact it is the expectation that the operations under the auspices of this institution will probably cover about three fourths of the total area to be surveyed. However, the successful execution of the plan requires the harmonious cooperation and concerted action of all civilized countries; accordingly, definite steps in this direction will be formulated in conformity with the advice of leading investigators.

A. *Magnetic Survey of the North Pacific Ocean.*—A wooden sailing-vessel, the brig, *Galilee,* of San Francisco, built in 1891, length 132.5 feet, breadth 33.5 feet, depth 12.7 feet, displacement about 600 tons, carrying a crew of eight men and sailing-master, has been chartered and is now being fully adapted for the purposes of the expedition.

The scientific leader and commander of the vessel—Mr. J. F. Pratt—is one of the most efficient officers of the United States Coast and Geodetic Survey. Commander Pratt has had thirty years' experience in astronomical, geodetic, hydrographic and magnetic work, and has had command both of sailing-vessels and of steamers engaged in coast-survey work. By the courtesy of the Secretary of Commerce and Labor and the Superintendent of the Coast and Geodetic Survey he has been granted the necessary furlough and will enter the temporary employ of the Carnegie Institution for the purpose of assisting in the inauguration of the magnetic survey of oceanic areas. The other members of the scientific corps will be Dr. J. Hobart Egbert, magnetic observer, surgeon and naturalist, and Mr. J. P. Ault, magnetic observer.

The first cruise will be in a region where the various methods to be employed can fully be tested and controlled, viz.: San Francisco, San Diego, Honolulu, Umanak, Aleutian Islands, Sitka. The magnetic elements are to be determined as follows: Declination by two compasses (a liquid one and a dry one) using various azimuth devices, horizontal intensity by a new method being devised which,

by some trials already made, appears promising, total intensity and dip with an L. C. dip circle. The expedition expects to leave San Francisco about the middle of July of this year. [It is gratifying to report that the German government has assured the president of the Carnegie Institution that its Samoan magnetic observatory will be maintained until 1909, to assist in the magnetic survey of the Pacific Ocean.]

B. *Land Work.*—Mr. J. P. Ault, magnetic observer, while temporarily assigned on the coast-survey steamer *Bache,* for securing the necessary training in magnetic work on a cruise from Baltimore to Panama, besides taking part in the sea work, has determined the three magnetic elements at the following stations: Norfolk (Virginia), Key West and Miami (Florida), Kingston (Jamaica), Colon (Panama), Havana, Mantanzas, Batabano and Pinar del Rio (all in Cuba) and Valdosta (Georgia). At Havana comparisons were also made with the instruments of the Colegio de Belen. Thus, most important secular variation and distribution data have been obtained.

Mr. D. C. Sowers, magnetic observer, accompanied the new coast-survey steamer *Explorer* from Baltimore to Porto Rico, determined the magnetic elements on land at Norfolk (Virginia), San Juan and Vieques (Porto Rico), and took part in the sea work. He is now engaged in determining the magnetic elements on various islands of the Lesser Antilles. Mr. G. Heimbrod, surveyor, of Suva, Figi Islands, enters the employ of the department the coming August, as magnetic observer. After assisting Dr. Franz Linke, in charge of the German magnetic observatory at Apia, Samoa, and securing the necessary experience in magnetic and electric work, he will be engaged in determining the magnetic elements on various islands in the South Pacific.

Definite arrangements are furthermore being perfected for securing in the near future observations along the coasts in Canada, Mexico, Central American countries, South America and China, while the oceanic survey is progressing. The precise details will be published later.

[In connection with above work it has become essential to make some experimental investigations at Washington, with the special view of ascertaining the cause of outstanding instrumental differences, and the reliability in the application of corrections derived by comparison, and the changes in the corrections for any particular set of instruments when used in various magnetic latitudes. These studies have an important bearing upon the inter-comparison and reduction of observatory standards, as well as the standardization and testing of instruments designed for field use.]

C. *Eclipse Work.*—Besides the cooperation already promised in the proposed magnetic and electric work during the eclipse of August 30, 1905, the department will have a station of its own at Palma, Majorca Island. The atmospheric electricity observations will be made by Professors Elster and Geitel and Dr. Harms. It will also have one or two stations in Canada, as may be necessary. Mr. J. E. Burbank, magnetician, will have charge of the work in atmospheric electricity in this country, and with that purpose in view has spent three months in Germany with Professors Wiechert, Elster and Geitel familiarizing himself with methods and perfecting the instrumental outfit.

D. *Magnetic Disturbances.*—For studying the correlation between solar phenomena and magnetic disturbances, cooperative work has been entered into between the Solar Observatory and the department of terrestrial magnetism of the Carnegie Institution. Two direct recording variometers, giving a visible record of the magnetic fluctuations and ringing an alarm for disturbances of a certain magnitude, are now being constructed under the direction of Dr. W. G. Cady, research magnetician, in accordance with his design.

Should the device prove successful, additional instruments will be constructed by the department and supplied to institutions ready to cooperate.

[This is the initial step towards the working out of a general plan for enlisting in magnetic work the cooperation of certain favorably situated and well-established institu-

tions, such as astronomical observatories, for example, in order to assist in bringing about a more uniform distribution than prevails at present, of stations contributing magnetic data.]

In the near future *additional appointments are to be made* in the department, the salaries ranging from $1,000 to $2,500 per annum, in accordance with qualifications and position.

The places to be filled call for a chief physicist, experienced magneticians capable of conducting investigations, magnetic observers for sea and land duty, and computers.

The appointments are not restricted to citizens of the United States.

Applications should contain full information regarding the applicant's life, education and experience. They may be sent in now and should be addressed to the Director, Department Terrestrial Magnetism, The Ontario, Washington, D. C., U. S. A.

L. A. BAUER,
Director.

May 25, 1905.

PRESIDENT ROOSEVELT ON THE REWARDS OF SCHOLARSHIP.[1]

THE general opinion of the community is bound to have a very great effect even upon its most vigorous and independent minds. If in the public mind the career of the scholar is regarded as of insignificant value when compared with that of a glorified pawnbroker, then it will with difficulty be made attractive to the most vigorous and gifted of our American young men. Good teachers, excellent institutions and libraries are all demanded in a graduate school worthy of the name. But there is an even more urgent demand for the right sort of student. No first-class science, no first-class literature or art, can ever be built up with second-class men.

The scholarly career, the career of the man of letters, the man of arts, the man of science, must be made such as to attract those strong and virile youths who now feel that they can only turn to business, law or politics. There is no one thing which will bring about this desired change, but there is one thing which will materially help in bringing it about, and that is to secure to scholars the chance of getting one of a few brilliant positions as prizes if they rise to the first rank in their chosen career. Every such brilliant position should have as an accompaniment an added salary, which shall help indicate how high the position really is; and it must be the efforts of the alumni which can alone secure such salaries for such positions.

As a people I think we are waking up to the fact that there must be better pay for the average man and average woman engaged in the work of education. But I am not speaking of this now; I am not speaking of the desirability, great though that is, of giving better payment to the average educator; I am speaking of the desirability of giving to the exceptional man the chance of winning an exceptional prize, just as he has the chance to do in law and business.

In business at the present day nothing could be more healthy than an immense reduction in the money value of the exceptional prizes thus to be won; but in scholarship what is needed is the reverse. In this country we rightly go upon the theory that it is more important to care for the welfare of the average man than to put a premium upon the exertions of the exceptional. But we must not forget that the establishment of such a premium for the exceptional, though of less importance, is nevertheless of very great importance. It is important even to the development of the average man, for the average of all of us is raised by the work of the great masters.

It is, I trust, unnecessary to say that I appreciate to the full the fact that the highest work of all will never be affected one way or the other by any question of compensation. And much of the work which is really best for the nation must from the very nature of things be non-remunerative as compared with the work of the ordinary industries and vocations. Nor would it ever be possible or desirable that the rewards of transcendent success in scholarship should even approximate, from a monetary standpoint, the rewards in other vocations.

[1] From his address to the alumni of Harvard College.

But it is also true that the effect upon ambitious minds can not but be bad if as a people we show our very slight regard for scholarly achievements by making no provision at all for its reward. The chief use of the increased money value of the scholar's prize would be the index thereby afforded of the respect in which it was popularly held.

The American scientist, the American scholar, should have the chance at least of winning such prizes as are open to his successful brother in Germany, England or France, where the rewards paid for first-class scholarly achievements are as much above those paid in this country as our rewards for first-class achievement in industry or law are above those paid abroad.

But of course what counts infinitely more than any possible outside reward is the spirit of the worker himself. The prime need is to instill into the minds of the scholars themselves a true appreciation of real as distinguished from sham success. In productive scholarship, in the scholarship which adds by its work to the sum of substantial achievement with which the country is to be credited, it is only first-class work that counts. In this field the smallest amount of really first-class work is worth all the second-class work that can possibly be produced; and to have done such work is in itself the fullest and amplest reward to the man producing it.

We outsiders should according to our ability aid him in every way to produce it. Yet all that we can do is but little compared to what he himself can and must do. The spirit of the scholar is the vital factor in the productive scholarship of the country.

MR. ROCKFELLER'S ENDOWMENT FOR HIGHER EDUCATION.

At a meeting of the General Education Board, held on June 30, a gift of ten million dollars was announced from Mr. John D. Rockefeller, as an endowment for higher education in the United States. The announcement of the gift was made in a letter from Mr. Frederick T. Gates, Mr. Rockefeller's representative, which reads as follows:

I am authorized by Mr. John D. Rockefeller to say that he will contribute to the General Education Board the sum of $10,000,000, to be paid October 1 next in cash, or, at his option, in income producing securities, at their market value, the principal to be held in perpetuity as a foundation for education, the income, above expenses and administration, to be distributed to or used for the benefit of such institutions of learning at such times, in such amounts, for such purposes and under such conditions, or employed in such other ways as the Board may deem best adapted to promote a comprehensive system of higher education in the United States.

Dr. Wallace Buttrick, one of the secretaries of the board, in a statement concerning the gift, says:

John D. Rockefeller, jr., with others in this city, was instrumental in forming the General Education Board in February, 1902. A very broad and admirable charter was secured from Congress, and signed by President Roosevelt on January 12, 1903.

A gift of one million dollars from Mr. John D. Rockefeller was immediately passed over to the Board, especially designated for educational work in the South. Other funds have been added by other philanthropists since that time, and the Board has confined its work hitherto mainly to educational work in the Southern States.

The present gift differs from Mr. Rockefeller's first gift to the Board in the following particulars: The principal sum of the gift of one million dollars made on the organization of the Board could be distributed. The present gift of ten million dollars is held as endowment, the income only being available for distribution. The first gift was designated to be used exclusively in the Southern States. The present gift is for use not only in the Southern States, but throughout the United States, without distinction of section. The first gift could be used for common schools and secondary education. The second gift is confined to higher education and is designed specially for colleges as distinguished from the great universities, although there is no prohibition in the letter of gift against making contributions to universities.

Both gifts are alike available for denominational schools, as well as for those which are non-sectarian. While the funds may be employed for denominational schools, they will be employed without sectarian distinctions. No special denomination will be particularly favored, but the funds

will be open to approved schools of all denominations, although they can not be employed for giving specifically theological instruction.

In distributing the funds the board will aim especially to favor those institutions which are well located and which have a local constituency sufficiently strong and able to insure permanence and power. No attempt will be made to resuscitate moribund schools or to assist institutions which are so located that they can not promise to be permanently useful.

Within these limits there are no restrictions as to the use of the income. It may be used for endowment, for buildings, for current expenses, for debts, for apparatus, or for any other purpose which may be found most serviceable.

It is known that Mr. Rockefeller has had this gift in contemplation for a long time, and Mr. Gates has been studying the subject in his behalf for many months. If the fund proves to be as useful as is now anticipated Mr. Rockefeller will undoubtedly make large additions to it in future years.

The present members of the board are as follows: Robert C. Ogden, chairman; George Foster Peabody, treasurer; Wallace Butterick, secretary and executive officer for the states south of the Potomac and Ohio Rivers, and Arkansas, Louisiana and Texas; Starr J. Murphy, secretary and executive officer for the states of the north and west; Frederick T. Gates, Daniel C. Gilman, Morris K. Jesup, Walter H. Page, Albert Shaw, John D. Rockefeller, Jr., Hugh H. Hanna, William R. Harper and E. Benjamin Andrews. There are four vacancies in the board which are expected to be filled later.

HONORARY DEGREES AT HARVARD UNIVERSITY.

AT the recent commencement Harvard University conferred seven honorary degrees. Those given to men of science, with the remarks made by President Eliot, were as follows:

Honorary Master of Arts.—Frederick Pike Stearns—chief engineer of the Metropolitan Water and Sewerage Board, with special charge of the waterworks, immense works in earth, masonry and metal, ten years in construction, planned and executed with good judgment, boldness and long foresight, and with demonstrated success as regards the adequacy, purity and reasonable cost of the supply.

Honorary Doctor of Science.—James Homer Wright—pathologist, both teacher and investigator, strong contributor to the advance of that biological science which holds out to mankind good promise of deliverance from mysterious evils long endured.

Doctors of Laws.—Henry Marion Howe—a Boston Latin School boy, Harvard bachelor of arts and Institute of Technology bachelor of science, an author on copper, iron and steel, distinguished for scientific imagination and a good English style, professor of metallurgy in Columbia University, consulting metallurgist honored by the profession in England, France, Germany, Russia and his native land. Reginald Heber Fitz—for thirty-five years a teacher of pathological anatomy and of the theory and practise of physic, skilful and acute diagnostician, much trusted consulted physician, sagacious contributor to the progress of medicine.

SCIENTIFIC NOTES AND NEWS.

YALE UNIVERSITY has conferred its doctorate of science on Professor George E. Hale, director of the Solar Observatory of the Carnegie Institution, and on Dr. T. W. Richards, professor of chemistry at Harvard University, and its degree of doctor of laws on Dr. Abraham Jacobi, emeritus professor of the diseases of children at Columbia University.

DARTMOUTH UNIVERSITY has conferred its doctorate of laws on Dr. C. L. Dana, a graduate of the class of '72, professor of nervous diseases in the Cornell Medical School.

DR. LUDWIG BOLTZMANN, the eminent mathematical physicist of Leipzig, arrived at Berkeley on June 26, where he will lecture before the summer school of the University of California.

PROFESSOR PAUL EHRLICH, of Frankfort-on-Maine, and Professor Ramón y Cajal, of Madrid, have been elected foreign associates of the Paris Academy of Medicine.

Dr. Julius Wiesner, professor of botany at Vienna, has been elected a member of the Danish Academy of Sciences.

Professor H. S. Graves, of the Forest School of Yale University, has returned to New Haven after his trip around the world. He paid special attention to forest conditions in India.

Dr. Arthur Schuster, professor of physics at the University of Manchester, has been nominated by the council of the Royal Society as one of their representatives on the committee of management appointed by the treasury for the Meteorological Office in London. He has also been elected as a representative of the council of the Royal Society on the council of the International Association of Academies.

By a unanimous vote of the board of trustees of the University of Pennsylvania the Rev. Dr. Hermann Vollrat Hilprecht, research professor of assyriology and professor of semitic philology and archeology of the University of Pennsylvania, was on June 27 acquitted of the charges recently brought against him concerning his integrity in the matter of his explorations in Babylonia.

M. Perrier has been reappointed for five years director of the Paris Museum of Natural History.

Mr. J. J. Lister, M.A., Fellow of St. John's College, Cambridge, has beeen nominated to occupy the university table at the laboratory of the Marine Biological Association at Plymouth.

Sir John Wolfe Barry has been elected to succeed the late Mr. James Mansergh as chairman of the British Engineering Standards Committee.

At the recent commencement at Union College, Schenectady, N. Y., the honorary degree of doctor of science was conferred on Olin H. Landreth, professor of engineering at that institution and consulting engineer of the New York State Board of Health.

At its thirty-eighth annual commencement Muhlenberg College conferred the degree of doctor of science on Professor Lewis M. Haupt, formerly of the U. S. Corps of Civil Engineers and late of the Nicaragua and Panama Canal Commission.

The degree of doctor of laws was conferred upon Professor John C. Hemmeter of Baltimore by St. John's College, Annapolis on June 21. In his address at the convocation exercises, Professor Hemmeter advocated the affiliation of St. John's College with the professional schools (medicine, law, dentistry, pharmacology) of the University of Maryland. In 1784 both these institutions formed a federation into the University of Maryland, which ceased to exist by the act of 1825. Professor Hemmeter is also in favor of including the Maryland Agricultural College (already largely owned and administered by the state) in the affiliation as the 'School of Agriculture and Technology' of the University of Maryland.

Mr. W. R. Sorley, M.A., of King's College, Cambridge, Knightbridge professor of moral philosophy, has been approved by the general board of studies for the degree of doctor in letters.

The De Morgan medal of the London Mathematical Society has this year been awarded to Dr. H. F. Baker, F.R.S., for his researches in pure mathematics.

The Hamburg prize for promoting progress in chemistry and pharmacognosy has been awarded this year to Professsor E. Schmidt of Marburg. The presidents of the British Pharmaceutical Society, the Chemical Society and the Linnean Society are members *ex officio* of the committee in charge of this biennial prize.

Mr. James Mansergh, F.R.S., a British engineer, well-known for his work on water-supply and sewage, died on June 15.

The University of the State of New York held its forty-third annual convocation at Albany on June 28, 29 and 30. The meeting was devoted to a discussion of industrial, commercial and agricultural education. Among those who took part were President Edmund J. James, of the University of Illinois; Mr. Robert T. Ogden, of New York; Mr. Frank A. Vanderlip, of New York; Professor J. W.

Jenks, of Cornell University, and Dean W. A. Henry, of the Wisconsin Agricultural Experiment Station.

INFORMATION from Ottawa states that the Dominion Astronomical Observatory has been practically completed. The telescope has been mounted, astronomer W. F. King, with his staff, has taken possession of the building and observation work has begun. The telescope is a refracting instrument 19 feet 6 inches long, with a 15-inch lens. In addition to the telescope, the observatory has transit spectroscopic instruments and the equipment of a first-class institution. The building cost $92,000 and the telescope $14,000.

AN astronomical observatory, to be known as the Cecil Duncombe Observatory, is to be established in connection with the University of Leeds. A building with an aluminium dome is being built at one of the highest points in the city, and in it will be placed the telescope recently presented to the university by Captain C. W. E. Duncombe, together with the transit instrument presented by the late Mr. W. E. Crossley.

DURING the present season the U. S. Geological Survey will undertake work in Alaska, as follows: An investigation of the gold placers of Beaver Creek will be made by Mr. R. W. Stone. The ore deposits of Berners Bay will be studied by Mr. C. W. Wright, those of the Ketchikan district and the Wrangell region by Messrs. F. E. and C. W. Wright. Stratigraphic and paleontologic investigations will be carried on in southeastern Alaska by Mr. E. M. Kindle in cooperation with Mr. F. E. Wright. The coal fields of Herendeen Bay will be investigated by Mr. Sidney Paige, who will also prosecute economic and stratigraphic studies on Kodiak Island. Mr. U. S. Grant, assisted by Mr. Paige, will make a geologic reconnaissance of the country about Prince William Sound and will investigate its mineral resources. A geologic reconnaissance of the Matanuska coal fields will be made by Mr. G. C. Martin. In the Nome region Messrs. F. H. Moffit and F. L. Hess will study the geology and mineral resources. They will also investigate the more important placer districts of Seward Peninsula, and Mr. Hess will examine the tin deposits of the York region. A geologic reconnaissance of the country around Yakutat Bay will be made by Professor R. S. Tarr, who will be assisted by Messrs. B. S. Butler and Lawrence Martin. A geologic reconnaissance in the Yukon-Tanana region, between Dawson and Fairbanks, will be undertaken by Messrs. L. M. Prindle, assisted by Mr. A. Knopf. Geologic and topographic surveys and investigations of mineral resources will be supervised by Mr. A. H. Brooks in southeastern Alaska, about Controller Bay, in Matanuska region, about Yakutat Bay, on Alaska Peninsula, Seward Peninsula, and in the Yukon-Tanana region. Geologic and topographic surveys of the country around Controller Bay will be made by Messrs. G. C. Martin, and A. G. Maddren, geologists, and Messrs E. G. Hamilton and W. R. Hill, topographers. A detailed topographic survey of the Solomon River region will be made by Mr. T. G. Gerdine, assisted by Messrs. W. B. Corse and B. A. Yoder. Topographic and geologic surveys will be made west of Fairbanks between Circle City and Chena by Messrs. D. C. Witherspoon and R. B. Oliver, topographers, and Mr. R. W. Stone, geologist.

DURING the field season of 1903, Mr. George C. Martin, of the United States Geological Survey, made an examination of the petroleum and coal fields in Alaska. A brief preliminary report of this investigation was included in a bulletin published by the survey last year. The final complete report is now available as Bulletin 250, under the title of 'The Petroleum Fields of the Pacific Coast of Alaska, with an Account of the Bering River Coal Deposits.' Indications of petroleum have been found in the Controller Bay, the Cooke Inlet and the Coal Bay regions. Though only a few wells have been drilled and it is too soon to predict an important future for the region as a petroleum producer, Mr. Martin's studies have shown that there is justification for further prospecting and that the region may yet be a source of illuminating oil. The petroleum is clearly a refining oil of the same general nature as Pennsylvania petroleum.

It resembles the latter in having a high proportion of the more volatile compounds and a paraffin base and in containing almost no sulphur. The Bering River coal, which comes from a field 12 to 25 miles inland from Controller Bay, is the best that has yet been found on the Pacific coast of North America. The coal area, as far as known, is restricted to the region north of Bering Lake and Bering River. It includes about 120 square miles. The physical properties of the coal are very much alike in all the seams and in all parts of the field visited by Mr. Martin. The coal resembles the harder bituminous coals of the east more than it does anthracite. It is doubtful, too, whether much of the coal could be sized so as to compete with anthracite coal for domestic use; and again, under ordinary handling it will probably crush to almost the same extent as the harder grades of semi-bituminous coal. That will not, of course, impair its value for steam purposes, but will necessitate careful handling if it is to compete with Pennsylvania or Welsh anthracite as a domestic fuel. The illustrations that accompany the report include geologic reconnaissance maps of the Controller Bay region and Cook Inlet oil field and sketch maps of the Cold Bay and Cape Yaktag petroleum fields, as well as an outline map showing the general location of the oil fields and the areas represented on the large-scale maps.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. John D. Rockefeller has given $1,000,000 to Yale University; other large gifts have been made towards the endowment fund of the university, the details of which have not been announced.

Mr. Stephen Moody Crosby, Dartmouth, '49, of Boston, has given $50,000 to the college toward the building fund. It was planned to raise $250,000 for this purpose, and Mr. Crosby's contribution completes that amount.

At a meeting of the board of trustees of the Iowa State College on June 7 at Ames, it was voted to confer the degree of bachelor of agricultural engineering on students who complete a prescribed course in this subject. Graduates of either engineering or agricultural courses are eligible after the completion of one year's advanced work. The Iowa State College is the first institution in America to organize comprehensive instruction in this line and prepare to confer the degree. Forty-nine agricultural students were graduated at Ames from the four year course in animal husbandry, agronomy, dairying and horticulture in the last class, including five who took advanced degrees.

Professor E. H. Moore, of the University of Chicago, and Professor J. Mark Baldwin, of the Johns Hopkins University, are giving courses of lectures on mathematics and psychology, respectively, in the summer school of the University of California.

The following appointments in the Sheffield Scientific School, Yale University, have been announced: assistant professor, Dr. Henry Andrew Bumstead, physics; instructors, Dr. Frank Bell Underhill, physiological chemistry; Mr. Beverly W. Kunkel, biology; Dr. Oliver C. Lester, physics; assistants in instruction, Mr. Clarence C. Perry, steam engine; Mr. Haroutune M. Dadourian, physics; Mr. William A. Lilley, Jr., descriptive geometry and drawing.

Dr. K. E. Guthe, associate physicist at the National Bureau of Standards, has been appointed professor of physics and head of the department of physics at the State University of Iowa.

Frederick C. Newcombe has been appointed professor of botany and Charles A. Davis, curator of the herbarium, at the University of Michigan.

Mr. Alexander Jay Wurts has received the first appointment to the faculty of the Carnegie Technical Schools, Pittsburg, that of professor and head of department of applied electricity.

M. W. Blackman, Ph.D. (Harvard, 1905), has been made instructor in comparative anatomy and embryology in the medical department of Western Reserve University.

Forrest Shreve, Ph.D., has been appointed Adams Bruce fellow at the Johns Hopkins University.